CLAIMS

What is claimed is:

1. An occupant restraint system comprising:

at least one modifier sensor that generates a modifier signal to enable or disable an occupant restraint system;

an occupant sensor assembly that generates an occupant signal representing multiple occupant characteristics;

a collision sensor assembly that generates a collision signal representing vehicle collision characteristics; and

a processing unit for receiving input comprised of said modifier, occupant, and collision signals and for generating at least one output signal based on said input that optimizes deployment of said occupant restraint system.

2. A system as set forth in claim 1 wherein said at least one modifier sensor includes an occupant presence sensor for determining whether an occupant is present within a predetermined area within the vehicle and wherein said modifier signal is generated as a positive modifier signal when the occupant is in said predetermined area and generates a negative modifier signal when the occupant is not in said predetermined area.

3. A system as set forth in claim 2 wherein transmission of said negative modifier signal to said processing unit disables said occupant restraint system.

4. A system as set forth in claim 1 wherein said at least one modifier sensor includes a child seat sensor for determining whether a child seat is properly positioned within a predetermined area and wherein said modifier signal is generated as a positive modifier signal when said child seat is properly positioned within said predetermined area and is generated as a negative modifier signal when said child seat is improperly positioned within said predetermined area.

5. A system as set forth in claim 4 wherein transmission of said negative modifier signal to said processing unit disables said occupant restraint system.

6. A system as set forth in claim 1 wherein said at least one modifier sensor includes a seat belt usage sensor for determining whether a set belt harness is being utilized by the occupant and wherein said modifier signal is generated as a positive modifier signal when said seat belt harness is in an engaged position and is generated as negative modifier signal when said seat belt harness is in a disengaged position.

7. A system as set forth in claim 6 wherein said at least one output signal includes a retractor control signal for controlling deployment of a seat belt retractor to reduce forward momentum of the occupant when said processing unit receives a positive modifier signal and for disabling said seat belt retractor when said processing unit receives a negative modifier signal.

8. A system as set forth in claim 1 wherein said at least one modifier sensor is comprised of an occupant presence sensor for determining whether an occupant is present within a predetermined area within the vehicle, a child seat sensor for determining whether a child seat is properly positioned within said predetermined area, and a seat belt usage sensor for determining whether a seat belt harness is being utilized by the occupant and wherein said occupant presence sensor generates an occupant signal that is positive when the occupant is in said predetermined area and negative when the occupant is not in said predetermined area, said child seat sensor generates a child seat signal that is positive when said child seat is properly positioned within said predetermined area and negative when said child seat is improperly positioned within said predetermined area, and said seat belt usage sensor generates a seat belt signal that is positive when said seat belt harness is in an engaged position and negative when said seat belt harness is in a disengaged position, said modifier signal being comprised of said occupant presence, child seat, and seat belt signals.

9. A system as set forth in claim 1 wherein said occupant sensor assembly includes a weight sensor for generating a weight signal representing occupant weight and an occupant proximity sensor for generating an occupant proximity signal representing occupant position relative to a deployment area for said occupant restraint system, said occupant signal being comprised of said weight and proximity signals.

10. A system as set forth in claim 9 wherein said collision sensor assembly includes a severity sensor for generating a severity signal representing collision characteristics occurring at the time of or just after collision and a pre-collision sensor for generating a pre-collision signal representing vehicle characteristics occurring just before collision, said collision signal being comprised of said severity and pre-collision signals.

11. A system as set forth in claim 1 wherein said occupant restraint system includes an airbag assembly with an airbag controller for inflating and deflating an airbag and a seat belt assembly having a seat belt pretensioner mechanism and a seat belt retractor mechanism.

12. A system as set forth in claim 11 wherein said input to said processing unit is comprised of a plurality of input signals including said modifier signal comprised of an occupant presence signal, a child seat signal, and a seat belt usage signal, said occupant signal comprised of an occupant weight signal and an occupant proximity signal, and said collision signal comprised of a collision severity signal and a pre-collision signal.

13. A system as set forth in claim 12 wherein said at least one output signal is comprised of a plurality of output signals including a multi-stage inflation control signal for controlling the profile of said airbag, a variable venting control signal for controlling deflation speed of said airbag, and a retractor control signal for controlling the retraction force of said seat belt retractor mechanism.

14. A system as set forth in claim 13 including a fuzzy logic control system for optimizing said plurality of output signals based on said plurality of input signals.

15. An occupant restraint system comprising:

an airbag assembly with an airbag controller for inflating and deflating an airbag;

a seat belt assembly having a seat belt pretensioner mechanism and a seat belt retractor mechanism;

a plurality of modifier sensors including a occupant presence sensor for generating an occupant presence signal indicating whether an occupant is present in a predetermined area, a child seat sensor for generating a child seat position signal indicating whether a child seat is properly installed within said predetermined area, and a seat belt usage sensor for generating a seat belt signal indicating whether a seat belt is in an engaged or disengaged position;

a plurality of occupant sensors including an occupant weight sensor for generating an occupant weight signal and an occupant position sensor for generating an occupant position signal indicating the position of the occupant relative to an occupant restraint system deployment area;

a plurality of collision sensors including a severity sensor for generating a severity signal indicating collision characteristics occurring at the time of or just after collision and a pre-collision sensor for generating a pre-collision signal indicating vehicle characteristics occurring just before collision; and

a processing unit for receiving multiple input signals comprised of said occupant presence, child seat, seat belt, occupant weight, occupant position, severity, and pre-collision signals and for generating multiple output signals including a multi-stage inflation control signal for controlling the profile of said airbag, a variable

venting control signal for controlling deflation speed of said airbag, and a retractor control signal for controlling the retraction force of said seat belt retractor mechanism.

16. A system as set forth in claim 15 wherein said processing unit includes a fuzzy logic control system for optimizing said multiple output signals based on said multiple input signals.

17. A system as set forth in claim 16 wherein said occupant presence signal is either a positive occupant presence signal indicating the occupant is present in said predetermined area or a negative occupant presence signal indicating the occupant is not present in said predetermined area; said child seat signal is either a positive child seat signal indicating said child seat is properly installed within said predetermined area or a negative child seat signal indicating said child seat is improperly installed within said predetermined area; and said seat belt signal is either a positive seat belt signal indicating said seat belt is engaged or a negative seat belt signal indicating said seat belt is disengaged wherein said negative occupant presence and negative child seat signals disables said airbag controller to prevent inflation of said airbag and said negative seat belt signal disables said seat belt pretensioner and retractor mechanisms.

18. A method for controlling an occupant restraint system comprising the steps of :

(a) generating at least one modifier signal to enable or disable an occupant restraint system based on satisfaction of a predetermined condition;

(b) generating an occupant signal representing multiple occupant characteristics;

(c) generating a collision signal representing vehicle collision characteristics; and

(d) transmitting the modifier, occupant, and collision signals as multiple input signals to a processing unit; and

(e) generating at least one output signal based on the input signals to optimize deployment of the occupant restraint system.

19. A method as set forth in claim 18 wherein step (a) includes the steps of generating a first modifier signal having either a positive occupant presence signal indicating that an occupant is present in a predetermined area or a negative occupant presence signal indicating that the occupant is not in the predetermined area; generating a second modifier signal having either a positive child seat signal indicating that a child seat is properly installed within the predetermined area or a negative child seat signal indicating that the child seat is not present or is improperly installed within the predetermined area; and generating a third modifier signal having either a positive seat belt usage signal indicating that a seat belt is in an engaged position or a negative seat belt usage signal indicating that the seat belt is in a disengaged position.

20. A method as set forth in claim 19 wherein step (e) includes the step of modifying the output signal to disable the occupant restraint system when either the negative occupant presence signal, the negative child seat signal, or the negative seat belt usage signal is generated.

21. A method as set forth in claim 20 wherein step (e) includes the step of continuing to process the output signal when either the positive occupant presence signal, the positive child seat signal, or the positive seat belt usage signal is generated.

22. A method as set forth in claim 20 wherein step (e) includes utilizing the output signal to control inflation and deflation of an airbag and to control operation of a seat belt assembly having a seat belt pretensioner mechanism and a seat belt retractor mechanism.

23. A method as set forth in claim 20 wherein step (e) includes generating a plurality of output signals including generating a multi-stage inflation control signal for controlling the profile of the airbag, generating a variable venting control signal for controlling deflation speed of the airbag, and generating a retractor control signal for controlling the retraction force of the seat belt retractor mechanism.

24. A method as set forth in claim 23 including programming the processing unit with a fuzzy logic analysis process to generate the plurality of output signals based on the plurality of input signals before step (e).

25. A method as set forth in claim 24 wherein step (b) includes generating an occupant weight signal and an occupant proximity signal indicating position of the occupant relative to the airbag.

26. A method as set forth in claim 25 wherein step (c) includes generating a severity signal indicating vehicle characteristics at or after collision and generating a pre-collision signal indicating vehicle characteristics before collision.

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27. A method as set forth in claim 18 including utilizing a fuzzy logic analysis process to generate the output signal based on the plurality of input signals before step (e) wherein the fuzzy logic analysis process includes the steps of creating membership functions by assigning names to predetermined values within a designated range; designating rules to be applied to the input signals; evaluating the rules and input signals to form an optimal control decision; and translating the optimal control decision into the output signal.

28. A method as set forth in claim 18 including the step of programming the processing unit with a neural network for learning vehicle characteristics unique to vehicle type.

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